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General practitioners contact and its impact on depressive symptoms of residents during the COVID-19 pandemic and lockdown: a large community-based study in Hangzhou, China

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**General practitioners contact and its impact on depressive symptoms
of residents during the COVID-19 pandemic and lockdown: a large
community-based study in Hangzhou, China**

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39 **Keywords:** COVID-19, Depressive symptoms, General practitioner, Primary care,
40 Noncommunicable diseases

Abstract

Objectives To determine GP contact's impact on depressive symptoms during the COVID-19 pandemic and lockdown in China.

Design In April 2020, the follow-up survey was performed based on the baseline survey between October 2018 and May 2019.

Setting This survey was embedded in the Stanford Wellness Living Laboratory-China (WELL China) study, an ongoing prospective community-based cohort study, between 2018 and 2019.

Participants The survey was conducted by telephone interview to 4144 urban adult residences participating in the WELL China study at baseline, and 3,356 responded to this survey. We collected information on socio-demographic characteristics, depressive symptoms, and GP contact during the lockdown period (i.e. February to March 2020).

Primary and secondary outcome measures Depressive symptoms were measured by the WHO-5 questionnaire. WHO-5 consists of five question items that briefly indicate psychological wellbeing. Logistic regression models were applied to assess the association between GP contact and depressive symptoms.

Results 3,356 responded to the survey and 203 participants were excluded due to missing data on depressive symptoms, thus, 3,153 participants were left to the present study. 449 participants had GP contact during the lockdown. GP contact was significantly associated with the prevalent depressive symptoms (OR, 0.67; 95% CI: 0.51-0.89; $P < 0.01$) and with the incident depressive symptoms (OR, 0.68; 95% CI:

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62 0.51-0.93; $P < 0.05$). Stratified analysis showed that the negative association between
63 depressive symptoms of residents and GP contact was statistically significant in
64 individuals, who were middle-aged (45-64 years old) ($P < 0.01$), who had middle or
65 high education ($P < 0.01$), and had self-reported non-communicable diseases ($P < 0.05$).
66 **Conclusions** The contact with GPs may reduce the risk of depressive symptoms among
67 the community population during the COVID-19 pandemic and lockdown. Given the
68 possibility of further waves of COVID-19 infections, GP contact in communities should
69 be enhanced.

Strengths and limitations of this study

A major strength of the study is the follow-up study, which contains the WHO-Five

Well-being index from baseline and lockdown.

The response rate in our follow up survey was 81%, and we have built strong

relationships with communities and residents.

The seasonal characteristics of the baseline and lockdown periods were similar.

A major limitation of the study is the information were collected via telephone

interviews.

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78 **Introduction**

79 The outbreak of coronavirus disease 2019 (COVID-19) has had negative health impacts
80 around the world. According to the World Health Organization (WHO), there were
81 134,508,532 confirmed cases of COVID-19 causing 2,914,774 deaths by April 09,
82 2021¹. COVID-19 is not only threatening on physical health but also impacting on
83 short-term and long-term mental health ^{2 3}.

84 The COVID-19 outbreak changed to our lifestyle, such as restricted movements,
85 temporary unemployment, new realities of working from home, lack of physical contact
86 with other family members, friends and colleagues, home-schooling of children, and so
87 on⁴. The changes added the fear of contracting the virus. Psychological impacts during
88 lockdown have been reported⁵. Stressful life events, pessimism, home quarantine, and
89 increased social media exposure have been reported to influence mental health during
90 lockdown, exacerbating various mental health conditions, including depression, anxiety,
91 and grief-related symptoms^{6 7}. Good mental health is fundamental to overall health and
92 well-being². This is important for the management of mental health problems both in
93 the short term and long term of COVID-19. However, there is no best practice to
94 manage COVID-19 related mental health issues.

95 In response to the outbreak of COVID-19 in China in late January, 2020, general
96 practitioners (GPs) have acted as frontline health workers in the community healthcare
97 response to the epidemic^{8 9} undertaking responsibilities including the dissemination of
98 up-to-date prevention methods, monitoring of health status, guidance of appropriate

99 responses, and provision of prompt treatment for diseases among residents^{10 11}.

100 However, there is no evidence to support the impact of being contacted by GPs on
101 mental health.

102 Given the possibility of further waves of COVID-19 infections^{12 13}, it is important to
103 understand the role of GPs in community-based prevention and control of COVID-19,
104 including the impact of GP contact on mental health. Therefore, in the present study,
105 we investigated the effects of being contacted by GPs via telephone (GP contact) on
106 depressive symptoms among community residents before and during the COVID-19
107 lockdown period in Hangzhou, China. These findings may inform new healthcare
108 initiatives to meet future challenges.

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Methods

Study design and participants

Telephone interviews were conducted in April 2020 in 4,144 residents who participated in the baseline survey of the Stanford Wellness Living Laboratory-China (WELL China) study between October 2018 and May 2019 in Gongshu District, Hangzhou, Zhejiang, China¹⁴. Of the 4,144 baseline participants, 3,356 responded to the survey, with a response rate of 81%. We excluded 203 participants due to missing data regarding educational attainment (n = 29), WHO-Five Well-being index (WHO-5) values at baseline (n = 3), WHO-5 values during lockdown in response to the COVID-19 outbreak (n = 45), or GP contact (n = 126). In total, 3,153 participants were included in the final analysis.

Data collection and variable definitions

At the baseline survey between October 2018 and May 2019, face to face interviews were performed to collect demographic characteristics, WHO-5 and history of clinical diagnoses. In the follow-up survey in April, 2020, we collected WHO-5 data and information about GP contact with residents via telephone during lockdown between February and March, 2020, in response to the COVID-19 outbreak.

In the present study, we used the WHO-5 to indirectly assess depressive symptoms. The WHO-5 is a short questionnaire consisting of five simple, non-invasive questions reflecting wellbeing^{10 11}, which includes the following five items¹⁵: (1) “I have felt

cheerful and in good spirits”, (2) “I have felt calm and relaxed”, (3) “I have felt active and vigorous”, (4) “I woke up feeling fresh and rested” and (5) “My daily life has been filled with things that interest me”. Participants reported their feelings (WHO-5 index) during lockdown on a 6-point scale ranging from “all of the time” (5 points) to “at no time” (0 points). A summed score below 13, or scores of 0 or 1 for any item, were considered to indicate depressive symptoms¹⁰.

GP contact was defined as GPs providing health guidance, including advice regarding health improvement, the management of non-communicable diseases (NCDs) and preventing infectious disease, to residents with or without NCDs via telephone during the COVID-19 pandemic and lockdown.

NCDs included the history of hypertension, diabetes, clinically diagnosed cardiovascular disease, cancer, endocrine and metabolic diseases, osteoarthritis, respiratory system diseases, digestive system diseases, mental diseases, nervous system diseases, urinary system diseases, immune diseases, and allergies at baseline.

Statistical analysis

T-tests and χ^2 tests were used to examine participants’ characteristics according to GP contact status. Logistic regression analysis was performed to test the association between GP contact (yes/no) and prevalent and incident depressive symptoms which baseline depressive symptoms had been excluded to test for incident. Results are presented as odds ratios (ORs) and 95% confidence intervals (CIs). Model 1 adjusted

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for age, gender, educational attainment, and marital status. Model 2 additionally adjusted for NCDs. Model 3 additionally adjusted for depressive symptoms at baseline.

Moreover, stratified analysis was conducted based on: (1) age groups (young [18-44 years old], middle-aged [45-64 years old], and older [≥ 65 years old]); (2) educational attainment groups (illiterate or primary school, middle school or high school, and college or above); and (3) groups with or without NCDs.

Data analysis was performed using R software (R version 4.0.2). The threshold for statistical significance was set at $p < 0.05$ (two-sided).

Ethics statement

This study was approved by the Institutional Review Boards the Stanford University, CA, USA (IRB-35020) and Zhejiang University, Hangzhou, China (No. ZGL201507-3). Informed consent was obtained from all participants.

Patient and public involvement

No patients or the public were involved in the study design, setting the research questions, interpretation or writing up of results, or reporting of the research.

Results

Of 3,153 participants, 2,704 had no GP contact, while 449 participants had GP contact during lockdown. Socio-demographic characteristics and NCDs at baseline among participants with and without GP contact via telephone (GP contact) during the COVID-19 lockdown are shown in **Table 1**. The results revealed significant differences in age, educational attainment, marital status, and NCDs between participants with and without GP contact ($P < 0.05$). Participants with and without GP contact did not differ in sex ($P > 0.05$).

Table 2 shows the ORs and 95% CIs of depressive symptoms at baseline and during lockdown for participants who had GP contact during COVID-19 lockdown. In our telephone interview study of 3153 individuals, depressive symptoms among residents at baseline were analyzed according to GP contact during lockdown, revealing that those who were or were not contacted by GPs had no differences in prevalent depressive symptoms at baseline ($P > 0.05$) (Table 2, top panel). For the analysis of the prevalent depressive symptoms during COVID-19 lockdown, GP contact was associated with a lower risk of depressive symptoms of residents (OR = 0.67, $P = 0.005$) after adjusting for age, gender, educational attainment, marital status, and NCDs and depressive symptoms at baseline (in Table 2 middle panel). For the analysis of new cases of depressive symptoms assessed by WHO-5 scores occurring after baseline (incident depressive symptoms), we further excluded 431 subjects with depressive symptoms assessed by WHO-5 scores at baseline (prevalent cases of depressive

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symptoms), leaving 2722 individuals in the analysis. The associations between incident depressive symptoms of residents and GP contact during COVID-19 lockdown are shown in Table 2 (bottom panel). After adjusting for age, gender, educational attainment, marital status, and NCDs at baseline, those with GP contact were less likely to develop incident depressive symptoms ($OR = 0.68, P = 0.02$)

Associations between prevalent depressive symptoms of residents and GP contact during COVID-19 lockdown in individuals with and without NCDs are shown in **Table 3**. After adjusting for age, gender, educational attainment, marital status, and depressive symptoms at baseline, among individuals with NCDs, depressive symptoms of residents were negatively associated with GP contact during COVID-19 lockdown ($OR = 0.67, P = 0.01$). In individuals without NCDs, no significant associations were found between depressive symptoms of residents and GP contact during lockdown ($P > 0.05$).

Furthermore, we assessed the associations between prevalent depressive symptoms of residents and GP contact by age group (**Table 4**). After adjusting for gender, educational attainment, marital status, NCDs, and depressive symptoms at baseline, in the middle-aged group, GP contact was associated with a lower risk of depressive symptoms of residents during COVID-19 lockdown ($OR = 0.53, P = 0.005$). In the young and older groups, no significant differences were found between depressive symptoms of residents and GP contact during lockdown ($P > 0.05$).

Table 5 shows the associations between prevalent depressive symptoms of residents and GP contact during COVID-19 lockdown in three educational attainment

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4 210 groups. After adjusting for age, gender, marital status, NCDs, and depressive symptoms
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7 211 at baseline, among individuals in the middle-school or high school educational
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10 212 attainment group, GP contact was associated with a lower risk of depressive symptoms
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12 213 during COVID-19 lockdown (OR = 0.60, $P = 0.007$). In the illiterate or primary school
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15 214 group and the college or above group, no significant relationships were found between
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Discussion

In the present study, residents with GP contact were less likely to have prevalent depressive symptoms and less likely to develop new depressive symptoms during the COVID-19 pandemic and lockdown between February and March, 2020, in Gongshu District, Hangzhou, China. There was no difference in baseline depressive symptoms (from October 2018 to May 2019) between residents with and without GP contacts.

Some strategies were proposed for managing the mental health of COVID-19 patients or health workers caring for COVID-19 patients. For example, establishment of appropriate mental health-care systems for health workers¹⁶, the management of people with severe mental illness¹⁷, the psychological recovery of COVID-19 survivors¹⁸, application of the Integrative Group Treatment Protocol to health workers¹⁹, and so on. These studies mainly focused on the COVID-19 patients or health workers and more professional mental health workers were required. Although the populations need to be more attentions, normal residents still need to be cared on mental health during the COVID-19 pandemic and lockdown.

To the best of our knowledge, this is the first study to report the effects of GP contact with residents on mental health during COVID-19 lockdown. Previous studies have reported negative psychological impacts of quarantine^{6 20 21} related to overwhelming stress, including unemployment, death, and isolation caused by the COVID-19 outbreak²². Thus relieving fear in the community has been considered an important task¹¹. GPs with good communication skills may provide psychological counselling and

support to relieve fear and panic via telephone- and internet-based communication. On the other hand, residents may have had more reliance on GPs during the emergency period, enabling GP contact to play an intervening role in residents' mental health during lockdown.

NCDs, including diabetes mellitus, endocrine dysfunction, cardiovascular diseases, inflammation, asthma, etc. may co-occur with diagnosed or undiagnosed depression²³. Under normal circumstances, GPs provide health guidance to residents, with a particular focus on patients with NCDs, via home visits, telephone contact, or face to face contact at community hospitals. Because residents with NCDs received more attention from GPs and had closer relationships with GPs, they may have relied more on GPs during lockdown compared with residents without NCDs. So, the mental health of residents with NCDs might be more likely to be affected by GPs.

In our study, we found that young (18-44 years) and older (≥ 65 years old) residents had a higher proportion of depressive symptoms than middle-aged residents (45-64 years) during lockdown (26.6% in young people, 17.7% in middle-aged people, 20.4% in older people). The results may suggest that young and older people were more likely to be affected by the COVID-19 outbreak leading to depressive symptoms. Although, in our study, the rates of GP contact increased from young to older age groups, only middle-aged residents with GP contact showed a significant decrease of depressive symptoms. We speculated that middle-aged residents may be more capable of resisting

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the various pressures resulting in depression, making it easier for GP contact to intervene positively in their mental health.

In the present study, we found a significantly decreased risk of having depressive symptoms only among middle or high school educational attainment residents who had a GP contact. To understand why middle or high school educational attainment was an advantage in the association between depressive symptoms and GP contact, we additionally analyzed the age distribution in this group (n = 1795), revealing that individuals in the middle-aged group (n = 1134) constituted 63.2% of the middle or high school education attainment group, in the young group (n = 189) constituted 10.5%, and in the elder group (n = 472) constituted 26.3%. We speculated that the negative association between depressive symptoms and GP contact among people with middle or high school education attainment was likely due to most of these individuals being middle-aged.

The study had several strengths. First, the present study consisted surveys of residents at baseline and during lockdown, this enabled comparisons of mental health, health assessment, socioeconomic status, lifestyle, disease condition, etc. among the residents between the baseline and lockdown periods. In addition, the seasonal characteristics of the baseline and lockdown periods were similar as the baseline survey was conducted approximately one year ahead of lockdown. Second, the response rate in our follow up survey was 81%, and we have built strong relationships with communities and residents. These relationships enabled us to conduct follow up surveys

to examine the situations of the residents during lockdown in this extremely difficult time. Third, we performed the stratified analysis of the relationship between depressive symptom from different characteristics of the population and GP contact. The results would be helpful to propose targeted strategy.

The study involved several limitations that should be addressed. First, due to COVID-19 pandemic, we were only able to collect information about the situations of residents during lockdown via telephone interviews. Second, we defined depressive symptoms using the WHO-Five Well-being index. Although the WHO-5 is not considered a gold standard for defining depression, it has been used in epidemiological studies to screen for depression, and WHO-5 scores were found to have a negative association with depressive symptoms. This association is reported to be stronger for mild to moderate symptoms^{25 26}. Third, we did not record the reasons for GP contact.

In response to the high prevalence of common mental disorders, including depression and anxiety disorders, the WHO proposed that primary care should include mental health²⁷. As the foundation of primary care in community health services and frontline workers in the prevention and control of infectious disease in the community²⁸, GPs play an important role in mental healthcare in the community²⁹. The present study further supports the notion that GPs play an important role in improving mental health, including depressive symptoms, particularly during public health emergencies. Although the system of health provision by GPs is constantly developing, when overwhelming numbers of patients require care, the quality and quantity of GP care is

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299 not sufficient^{28 30}. Thus, systems of healthcare provision by GPs in communities should
300 be enhanced, particularly given the risk of further waves of COVID-19 infection.

For peer review only

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Contributors Fei Yang, Wenhui Lin, Xueyin Zhao, and Shankuan Zhu designed the study. Fei Yang and Wenhui Lin analyzed the data and drafted the manuscript. Fei Yang, Wenhui Lin, Xueyin Zhao, Xiaochen Xu, and Xiaoyan Wang collected data. Fei Yang, Wenhui Lin, Eleanor Frost, Yan Min, Xiaochen Xu, Xiaoyan Wang, Wei Li, Yue Leng, Xueyin Zhao, Wei He, Ann W. Hsing and Shankuan Zhu provided comments and revised the manuscript. All authors approved the final version of the manuscript.

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Competing interests None declared.

Patient consent for publication Not required.

Data availability statement

Extra data is available by emailing Shankuan Zhu.

References

1. Organization WH. Coronavirus disease 2019 (COVID-19) update (Last updated: 2021-04-09) .

2. Yao H, Chen JH, Zhao M, et al. Mitigating mental health consequences during the COVID-19 outbreak: Lessons from China. *Psychiatry Clin Neurosci* 2020;74(7):407-08. doi: 10.1111/pcn.13018

3. Vahia IV, Jeste DV, Reynolds CF, 3rd. Older Adults and the Mental Health Effects of COVID-19. *JAMA* 2020;324(22):2253-54. doi: 10.1001/jama.2020.21753

4. Organization WH. Mental health & COVID-19. *Coronavirus disease (COVID-19) 2020*

5. Nachega JB, Grimwood A, Mahomed H, et al. From Easing Lockdowns to Scaling-Up Community-Based COVID-19 Screening, Testing, and Contact Tracing in Africa - Shared Approaches, Innovations, and Challenges to Minimize Morbidity and Mortality. *Clin Infect Dis* 2020 doi: 10.1093/cid/ciaa695

6. Gao J, Zheng P, Jia Y, et al. Mental health problems and social media exposure during COVID-19 outbreak. *PLoS One* 2020;15(4):e0231924. doi: 10.1371/journal.pone.0231924

7. Guessoum SB, Lachal J, Radjack R, et al. Adolescent psychiatric disorders during the COVID-19 pandemic and lockdown. *Psychiatry Res* 2020;291:113264. doi: 10.1016/j.psychres.2020.113264

8. Vermeulen L, Schafer W, Pavlic DR, et al. Community orientation of general practitioners in 34 countries. *Health Policy* 2018;122(10):1070-77. doi: 10.1016/j.healthpol.2018.06.012

- 344 9. Shu Z, Wang L, Sun X. An evaluation of the effects of general practitioner-supported
345 patient noncommunicable diseases control model in Shanghai, China. *Int J Health
346 Plann Manage* 2019;34(3):947-59. doi: 10.1002/hpm.2866
- 347 10. Liu Y, Wang Z, Ren J, et al. A COVID-19 Risk Assessment Decision Support System for
348 General Practitioners: Design and Development Study. *J Med Internet Res*
349 2020;22(6):e19786. doi: 10.2196/19786
- 350 11. Li DKT, Zhu S. Contributions and challenges of general practitioners in China fighting
351 against the novel coronavirus crisis. *Fam Med Community Health* 2020;8(2):e000361.
352 doi: 10.1136/fmch-2020-000361
- 353 12. Leung K, Wu JT, Liu D, et al. First-wave COVID-19 transmissibility and severity in China
354 outside Hubei after control measures, and second-wave scenario planning: a
355 modelling impact assessment. *Lancet* 2020;395(10233):1382-93. doi:
356 10.1016/S0140-6736(20)30746-7
- 357 13. Xu S, Li Y. Beware of the second wave of COVID-19. *Lancet* 2020;395(10233):1321-22.
358 doi: 10.1016/S0140-6736(20)30845-X
- 359 14. Min Y, Zhao X, Hsing AW, et al. Cohort Profile: WELL living laboratory in China (WELL-
360 China). *International journal of epidemiology* 2021 doi: 10.1093/ije/dyaa283
- 361 15. Topp CW, Ostergaard SD, Sondergaard S, et al. The WHO-5 Well-Being Index: a
362 systematic review of the literature. *Psychother Psychosom* 2015;84(3):167-76. doi:
363 10.1159/000376585

- 1
2
3
4 364 16. Zandifar A, Badrfam R, Mohammadian Khonsari N, et al. COVID-19 and medical staff's
5
6
7 365 mental health in educational hospitals in Alborz Province, Iran. *Psychiatry Clin*
8
9 366 *Neurosci* 2020;74(9):499-501. doi: 10.1111/pcn.13098
10
11
12 367 17. China NHCo. Notifications of strengthening treatment and management of severe mental
13
14
15 368 illness during the COVID-19 epidemic. 2020. 2020
16
17
18 369 18. Council JPacMotS. Guideline for psychosocial support during the COVID-19 epidemic.
19
20 370 2020
21
22
23 371 19. Torricelli L, Poletti M, Raballo A. Managing COVID-19-related psychological distress in
24
25
26 372 health workers: Field experience in northern Italy. *Psychiatry Clin Neurosci*
27
28 373 2021;75(1):23-24. doi: 10.1111/pcn.13165
29
30
31 374 20. Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how
32
33
34 375 to reduce it: rapid review of the evidence. *Lancet* 2020;395(10227):912-20. doi:
35
36 376 10.1016/S0140-6736(20)30460-8
37
38
39 377 21. Lai J, Ma S, Wang Y, et al. Factors Associated With Mental Health Outcomes Among
40
41
42 378 Health Care Workers Exposed to Coronavirus Disease 2019. *JAMA Netw Open*
43
44 379 2020;3(3):e203976. doi: 10.1001/jamanetworkopen.2020.3976
45
46
47 380 22. Shader RI. COVID-19 and Depression. *Clin Ther* 2020;42(6):962-63. doi:
48
49 381 10.1016/j.clinthera.2020.04.010
50
51
52 382 23. Lotfaliany M, Bowe SJ, Kowal P, et al. Depression and chronic diseases: Co-occurrence
53
54
55 383 and communality of risk factors. *J Affect Disord* 2018;241:461-68. doi:
56
57 384 10.1016/j.jad.2018.08.011
58
59
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2
3
4 385 24. Memel D. Chronic disease or physical disability? The role of the general practitioner. *Br J*
5
6
7 386 *Gen Pract* 1996;46(403):109-13.
8
9
10 387 25. Schlax J, Junger C, Beutel ME, et al. Income and education predict elevated depressive
11
12 388 symptoms in the general population: results from the Gutenberg health study. *BMC*
13
14
15 389 *Public Health* 2019;19(1):430. doi: 10.1186/s12889-019-6730-4
16
17
18 390 26. Gan Z, Li Y, Xie D, et al. The impact of educational status on the clinical features of major
19
20 391 depressive disorder among Chinese women. *J Affect Disord* 2012;136(3):988-92. doi:
21
22
23 392 10.1016/j.jad.2011.06.046
24
25
26 393 27. Organization WH. Integrating Mental health into primary care: A global perspective.
27
28 394 *Geneva: WHO* 2008
29
30
31 395 28. Kong X, Yang Y. The current status and challenges of community general practitioner
32
33
34 396 system building in China. *QJM* 2015;108(2):89-91. doi: 10.1093/qjmed/hcu222
35
36
37 397 29. Lam TP SK, Piterman L, Lam KF, Poon MK, See C, Wu D. Impact of training for general
38
39 398 practitioners on their mental health services: The Hong Kong experience. *Australian*
40
41
42 399 *journal of general practice* 2018;47(8):6.
43
44
45 400 30. Zhang Y, Zhao Q, Hu B. Community-based prevention and control of COVID-19:
46
47 401 Experience from China. *Am J Infect Control* 2020;48(6):716-17. doi:
48
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50 402 10.1016/j.ajic.2020.03.012
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6 404 **Table 1.** Socio-demographic characteristics, NCDs among participants and GP
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8 405 contact.

Variables	Total (n = 3,153)	GP contact		P
		No (n = 2,704)	Yes (n = 449)	
Age, y (mean ± SD)	55.5 ± 12.9	55.0 ± 12.9	59.0 ± 12.0	<0.001
Age Stratification, n (%)				<0.001
18-44	613 (100)	557 (90.9)	56 (9.1)	
45-64	1698 (100)	1474 (86.8)	224 (13.2)	
≥65	842 (100)	673 (79.9)	169 (20.1)	
Gender, n (%)				0.14
Male	1186 (100)	1003 (84.6)	183 (15.4)	
Female	1967 (100)	1701 (86.5)	266 (13.5)	
Educational attainment, n (%)				<0.001
Illiterate or primary school	672 (100)	563 (83.8)	109 (16.2)	
Middle school or high school	1795 (100)	1518 (84.6)	277 (15.4)	
College or above	686 (100)	623 (90.8)	63 (9.2)	
Marital status, n (%)				0.04
Married/ remarried	2915 (100)	2489 (85.4)	426 (14.6)	
Unmarried /Divorced/ separate	238 (100)	215 (90.3)	23 (9.7)	
NCDs, n (%)				<0.001
Without	1168 (100)	1047 (89.6)	121 (10.4)	
With	1985 (100)	1657 (83.5)	328 (16.5)	

38 406 NCDs, Chronic non-communicable disease.
39 407 The data of socio-demographic characteristics, NCDs of resiednts from baseline survey.
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41 408 The date of GP contact with residents from follow-up survey during COVID-19 lockdown.
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409 **Table 2.** Association between GP contact and depressive symptoms of residents

Variables	Total	GP contact	
		No	Yes
Depressive symptom	n (%)	n (%)	n (%)
Prevalent			
Baseline	n = 3,153	n = 2,704	n = 449
(before lockdown)			
No	2,722 (86.3)	2,329 (86.1)	393 (87.5)
Yes	431 (13.7)	375 (13.9)	56 (12.5)
Model 1 OR (95%CI), P		Ref	0.96 (0.70-1.29), 0.77
Model 2 OR (95%CI), P		Ref	0.94 (0.70-1.28), 0.71
Prevalent			
Lockdown	n = 3153	n = 2,704	n = 449
No	2,517 (79.8)	2,135 (79.0)	382 (85.1)
Yes	636 (20.2)	569 (21.0)	67 (14.9)
Model 1 OR (95%CI), P		Ref	0.68 (0.52-0.90), 0.007
Model 2 OR (95%CI), P		Ref	0.67 (0.51-0.88), 0.004
Model 3 OR (95%CI), P		Ref	0.67 (0.51-0.89), 0.005
Incident*	n = 2,722	n = 2,329	n = 393
No	2,210 (81.2)	1,873 (80.4)	337 (85.8)
Yes	512 (18.8)	456 (19.6)	56 (14.2)
Model 1 OR (95%CI), P		Ref	0.70 (0.52-0.95), 0.02
Model 2 OR (95%CI), P		Ref	0.68 (0.51-0.93), 0.02

410 NCDs, Chronic non-communicable disease.

411 Model 1: Adjusted for age, gender, educational attainment, marital status.

412 Model 2: Further adjusted for NCDs.

413 Model 3: Further adjusted for depressive symptom in baseline.

414 * Individuals who reported no depressive symptom a baseline but reported depressive symptoms at the
415 follow up interview in April 2020.

416 The data of socio-demographic characteristics, NCDs of residents from baseline survey.

417 The date of GP contact with residents from follow-up survey during COVID-19 lockdown .

418 The date of depressive symptom from baseline and follow-up survey.

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Table 3. The association between GP contact and prevalent depressive symptoms of residents stratified by NCDs group

Without NCDs n = 1,168				With NCDs n = 1,985		
		Without contact	With contact			
			OR (95% CI)	P		
Model 1	Ref		0.69 (0.40-1.20)	0.19	Ref	0.66 (0.48-0.92) 0.01
Model 3	Ref		0.69 (0.40-1.20)	0.19	Ref	0.67 (0.48-0.92) 0.01

NCDs, Chronic non-communicable disease.
Model 1: Adjusted for age, gender, educational attainment, marital status.
Model 3: Further adjusted for depressive symptom in baseline.
The data of socio-demographic characteristics, NCDs of residents from baseline survey.
The date of GP contact with residents from follow-up survey during COVID-19 lockdown .
The date of depressive symptom from baseline and follow-up survey.

Table 4. Association between GP contact and prevalent depressive symptoms of residents stratified by age group

	18-44 years n = 613			45-64 years n = 1,698			≥65 years n = 842		
	Without contact	With contact		Without contact	With contact		Without contact	With contact	
		OR (95% CI)	P		OR (95% CI)	P		OR (95% CI)	P
Model 1	Ref	0.78 (0.40-1.53)	0.48	Ref	0.55 (0.35-0.85)	0.007	Ref	0.81 (0.52-1.25)	0.35
Model 2	Ref	0.77(0.40-1.52)	0.46	Ref	0.53 (0.34-0.82)	0.004	Ref	0.81 (0.52-1.25)	0.34
Model 3	Ref	0.76 (0.38-1.48)	0.42	Ref	0.53 (0.34-0.82)	0.005	Ref	0.81 (0.52-1.25)	0.34

NCDs, Chronic non-communicable disease.

Model 1: Adjusted for gender, educational attainment, marital status.

Model 2: Further adjusted for NCDs.

Model 3: Further adjusted for depressive symptom in baseline.

The data of socio-demographic characteristics, NCDs of residents from baseline survey.

The date of GP contact with residents from follow-up survey during COVID-19 lockdown .

The date of depressive symptom from baseline and follow-up survey.

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435 **Table 5.** Association between GP contact and prevalent depressive symptoms of residents stratified by educational attainment groups.

		Illiterate or primary school			Middle school or high school			College or above		
		n = 672			n = 1,795			n = 686		
		Without	With		Without	With		Without	With	
		contact	contact		contact	contact		contact	contact	
			OR (95% CI)	P		OR (95% CI)	P		OR (95% CI)	P
Model 1	Ref		0.79 (0.46-1.39)	0.41	Ref	0.62 (0.43-0.89)	0.01	Ref	0.75 (0.39-1.46)	0.40
Model 2	Ref		0.78(0.45-1.37)	0.39	Ref	0.60 (0.42-0.87)	0.007	Ref	0.75 (0.38-1.45)	0.39
Model 3	Ref		0.78(0.44-1.37)	0.39	Ref	0.60 (0.42-0.87)	0.007	Ref	0.75 (0.39-1.46)	0.40

436 NCDs, Chronic non-communicable disease.
437 Model 1: Adjusted for age, gender, marital status.
438 Model 2: Further adjusted for NCDs.
439 Model 3: Further adjusted for depressive symptom in baseline
440 The data of socio-demographic characteristics, NCDs of resiednts from baseline survey.
441 The date of GP contact with residents from follow-up survey during COVID-19 lockdown .
442 The date of depressive syomptom from baseline and follow-up survey.

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1 **Association between contact with a general practitioner and**
2 **depressive symptoms during the COVID-19 pandemic and lockdown:**
3 **a large community-based study in Hangzhou, China**

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41 **Abstract**

42 **Objectives** To determine the association of GP contact with depressive symptoms
43 during the COVID-19 pandemic and lockdown in China.

44 **Design** In April 2020, a follow-up survey was conducted on the basis of a baseline
45 survey conducted between October 2018 and May 2019.

46 **Setting** The survey was embedded in the Stanford Wellness Living Laboratory-China
47 (WELL China) study, an ongoing prospective community-based cohort study during
48 2018–2019.

49 **Participants** The survey was conducted by telephone interview among 4,144 adult
50 urban residents participating in the WELL China study at baseline. We collected
51 information on sociodemographic characteristics, depressive symptoms, and GP
52 contact during the lockdown period (February to March 2020).

53 **Primary and secondary outcome measures** Depressive symptoms were measured
54 using the World Health Organization-Five Well-being Index (WHO-5), comprising five
55 questionnaire items that briefly indicate psychological well-being. Logistic regression
56 models were applied to assess the association between GP contact and depressive
57 symptoms.

58 **Results** In total, 3,356 participants responded to the survey; 203 were excluded owing
59 to missing data on depressive symptoms, leaving 3,153 participants in the present study.
60 During lockdown, 449 participants had GP contact. GP contact was significantly
61 negatively associated with prevalent depressive symptoms (odds ratio [OR], 0.67; 95%

confidence interval [CI]: 0.51–0.89; $P < 0.01$) and incident depressive symptoms (OR, 0.68; 95% CI: 0.51–0.93; $P < 0.05$). Stratified analysis showed a significant negative association between depressive symptoms and GP contact in individuals who were 45–64 years old ($P < 0.01$), had a middle or high education ($P < 0.01$), and had self-reported noncommunicable diseases ($P < 0.05$).

Conclusions Contact with GPs during the COVID-19 pandemic and lockdowns may have a negative association with depressive symptoms in community-dwelling populations. Given the possibility of further surges in COVID-19 infections, GP contact in the community should be enhanced.

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71 **Strengths and limitations of this study**

- 72 • This was a longitudinal study using the WHO-5, health assessment, and
- 73 sociodemographic characteristics at both baseline and during the lockdown period.
- 74 • The sample size of our study was large, which provided sufficient statistical power.
- 75 • Most respondents to the baseline survey responded to the follow-up survey.
- 76 • Selection bias may exist owing to the use of telephone interviews.
- 77 • Causation cannot be established owing to the cross-sectional study design.

Introduction

The outbreak of coronavirus disease 2019 (COVID-19) has had negative health impacts around the world. According to the World Health Organization (WHO), there were 134,508,532 confirmed cases of COVID-19 causing 2,914,774 deaths by April 9, 2021¹. COVID-19 is not only threatening to physical health but also has impacts on short- and long-term mental health. According to reports, the rate of depressive symptoms in the general population was 14.6%–48.3% during the COVID-19 epidemics in China, Spain, Italy, Iran, the United States, Turkey, Nepal, and Denmark, using different measurement tools². Furthermore, physical symptoms similar to COVID-19 infection can increase people's perceived risk and lead to adverse mental health outcomes, including depressive symptoms³.

The COVID-19 pandemic has changed people's lifestyles owing to restricted movements; temporary unemployment; new realities of working from home; lack of physical contact with family members, friends and colleagues; and homeschooling of children, among other factors⁴. Added to these changes is fear of contracting the disease. Psychological impacts during lockdowns have been reported⁵⁻⁸. Stressful life events, pessimism, home quarantine, social distancing, wearing face masks, and increased exposure to social media have been reported to influence mental health during lockdown, exacerbating various mental health conditions, including depression, anxiety, and grief-related symptoms⁹⁻¹². Good mental health is fundamental to overall health

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98 and well-being⁴. Thus, it is important to properly manage mental health problems both
99 in the short and long term during the COVID-19 pandemic.

100 In China, mental health during the COVID-19 pandemic has attracted attention.
101 Wang et al. found that during the initial stages of the outbreak in China, 16.5% of
102 respondents to an online survey reported moderate to severe depressive symptoms¹³. A
103 longitudinal study in a Chinese community-dwelling population showed that 4 weeks
104 after the pandemic peak, depressive symptoms were similar to those at the initial stage,
105 using the Depression, Anxiety and Stress Scale (DASS) depression subscale¹⁴.
106 Additionally, some surveys have focused on depression in a specific population, such
107 as patients with COVID-19, psychiatric patients, and workers returning to the
108 workplace after lockdown. Results from these studies suggest that patients with
109 COVID-19 and psychiatric patients are more vulnerable to and have relatively high
110 levels of depression.¹⁵⁻¹⁷ Studies have shown that personal precautionary measures,
111 confidence in doctors, and satisfaction with health education may relieve depression
112 and anxiety.^{13 14 18} Chinese general practitioners (GPs) may play an essential role
113 during the pandemic by giving professional support to people at risk of impaired mental
114 health.

115 Community-based prevention and control of mental diseases (or mental health) are
116 important for controlling the COVID-19 pandemic¹⁹. In response to the outbreak of
117 COVID-19 in China during late January 2020, GPs acted as frontline health workers in
118 the community health care response to the epidemic^{20 21}, undertaking responsibilities

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4 119 including the dissemination of up-to-date information regarding prevention methods,
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7 120 monitoring of patients' health status, guidance for appropriate responses, and provision
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10 121 of prompt treatment for diseases among local residents. Normally, GPs are involved in
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12 122 health improvement and the control of noncommunicable diseases (NCDs)^{21 22}. During
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15 123 the COVID-19 epidemic in China, GPs have contacted residents with or without NCDs
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18 124 via telephone. However, there is no evidence regarding the impact of such contact with
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21 125 a GP on mental health.

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23 126 Given the possibility of further surges in COVID-19 infections^{23 24}, it is important to
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26 127 understand the role of GPs in community-based prevention and control of COVID-19
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29 128 epidemics, including the impact of contact with a GP on mental health. Therefore, in
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32 129 the present study, we investigated the association between having contact with a GP by
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35 130 telephone (GP contact) and depressive symptoms among community residents before
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38 131 and during the COVID-19 lockdown period in Hangzhou, China. These findings may
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41 132 inform new health care initiatives to meet future challenges.
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Methods

Study design and participants

Telephone interviews were conducted in April 2020 among 4,144 urban residents who participated in the baseline survey of the Stanford Wellness Living Laboratory-China (WELL China) study between October 2018 and May 2019 in Gongshu District, Hangzhou City in Zhejiang, China, which is an urban area.²⁵. Of the 4,144 baseline participants, 3,356 responded to the survey, with a response rate of 81%. We excluded 203 participants owing to missing data regarding educational attainment (n = 29), World Health Organization-Five Well-being Index (WHO-5) values at baseline (n = 3), WHO-5 values during lockdown in response to the COVID-19 outbreak (n = 45), or GP contact (n = 126). In total, 3,153 participants were included in the final analysis.

Data collection and variable definitions

At the baseline survey between October 2018 and May 2019, face-to-face interviews were performed to collect demographic characteristics, WHO-5 data, and history of clinical diagnoses. In the follow-up survey in April 2020, we collected WHO-5 data and information about GP contact with residents via telephone during lockdown in response to the COVID-19 outbreak between February and March in 2020.

In the present study, we used the WHO-5 to indirectly assess depressive symptoms. The WHO-5 is a short questionnaire comprising five simple, noninvasive questions reflecting well-being, which includes the following five items²⁶: (1) “I have felt cheerful

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4 154 and in good spirits,” (2) “I have felt calm and relaxed,” (3) “I have felt active and
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7 155 vigorous,” (4) “I woke up feeling fresh and rested,” and (5) “My daily life has been
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10 156 filled with things that interest me.” Participants reported their feelings (WHO-5 index)
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12 157 during lockdown on a 6-point scale ranging from “all of the time” (5 points) to “at no
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15 158 time” (0 points). A summed score less than 13, or scores of 0 or 1 for any item, are
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17 159 considered to indicate depressive symptoms.²⁷ Although the WHO-5 is not considered
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20 160 the gold standard for defining depression, it has relatively good psychometric
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23 161 performance in terms of reliability and validity, and it has a strong correlation with
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26 162 depressive symptoms²⁶. The WHO-5 can be used as a sensitive and specific screening
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29 163 tool for depression in epidemiological studies. Considering the time limit of telephone
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32 164 interviews, we chose to use the WHO-5 as an indicator of depressive symptoms in this
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34 165 large population health survey.

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36 166 GP contact was defined as a GP providing health guidance, including advice
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39 167 regarding health improvement, the management of noncommunicable diseases (NCDs)
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42 168 and prevention of infectious diseases, to residents with or without NCDs via telephone
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45 169 during the COVID-19 pandemic and lockdown.

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47 170 NCDs included a history of hypertension, diabetes, clinically diagnosed
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53 172 respiratory system diseases, digestive system diseases, mental diseases, nervous system
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56 173 diseases, urinary system diseases, immune diseases, and allergies at baseline.

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Statistical analysis

We used *t*-tests and χ^2 tests to analyze participants' characteristics according to GP contact status. Logistic regression analysis was performed to test the association between GP contact (yes/no) and prevalent and incident depressive symptoms; baseline depressive symptoms were excluded to test for incident symptoms. Results are presented as odds ratios (ORs) and 95% confidence intervals (CIs). Model 1 adjusted for age, sex, educational attainment, and marital status. Model 2 additionally adjusted for NCDs. Model 3 additionally adjusted for depressive symptoms at baseline.

We conducted stratified analysis according to: (1) age group (young, 18–44 years old; middle-aged, 45–64 years old; and older, ≥ 65 years old); (2) educational attainment groups (illiterate or primary school, middle school or high school, and college or above); and (3) groups with or without NCDs.

Data analysis was performed using R software version 4.0.2 (The R Project for Statistical Computing, Vienna, Austria). The threshold for statistical significance was set at $p < 0.05$ (two-sided).

Ethics statement

This study was approved by the Institutional Review Boards of Stanford University, CA, USA (IRB-35020) and Zhejiang University, Hangzhou, China (No. ZGL201507-3). Informed consent was obtained from all participants.

196 **Patient and public involvement**

197 No patients or the public were involved in the study design, setting the research
198 questions, interpretation or writing up of the results, or reporting of the research.

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Results

Of 3,153 participants, 449 participants had contact with a GP and 2,704 had no contact with a GP during the COVID-19 lockdown. Sociodemographic characteristics and NCDs at baseline among participants with and without GP contact via telephone (GP contact) during lockdown are shown in **Table 1**. The results revealed significant differences in age, educational attainment, marital status, and NCDs between participants with and without GP contact ($P < 0.05$). Participants with and without GP contact did not differ according to sex ($P > 0.05$).

Table 2 shows the ORs and 95% CIs of depressive symptoms at baseline and during lockdown for participants who had GP contact during the COVID-19 lockdown. In our telephone interview study of 3,153 individuals, depressive symptoms among residents at baseline were analyzed according to GP contact during lockdown, revealing no differences in prevalent depressive symptoms at baseline between those who were or were not contacted by a GP ($P > 0.05$) (Table 2, top panel). In the analysis of prevalent depressive symptoms during lockdown, GP contact was associated with a lower risk of depressive symptoms among respondents ($OR = 0.67$, $P = 0.005$), after adjusting for age, sex, educational attainment, marital status, and NCDs and depressive symptoms at baseline (Table 2, middle panel). In the analysis of new cases of depressive symptoms occurring after baseline (incident depressive symptoms) assessed using WHO-5 scores, we further excluded 431 individuals with depressive symptoms at baseline (prevalent cases of depressive symptoms) assessed using WHO-5 scores, leaving 2,722

individuals in the analysis. The associations between incident depressive symptoms among residents and GP contact during the COVID-19 lockdown are shown in Table 2 (bottom panel). After adjusting for age, sex, educational attainment, marital status, and NCDs at baseline, individuals who had contact with a GP were less likely to develop incident depressive symptoms ($OR = 0.68$, $P = 0.02$)

Associations between prevalent depressive symptoms and GP contact during lockdown among individuals with and without NCDs are shown in **Table 3**. After adjusting for age, sex, educational attainment, marital status, and depressive symptoms at baseline, depressive symptoms were negatively associated with GP contact during the COVID-19 lockdown ($OR = 0.67$, $P = 0.01$) among individuals with NCDs. In individuals without NCDs, no significant associations were found between depressive symptoms and GP contact during lockdown ($P > 0.05$).

We further assessed the associations between prevalent depressive symptoms among residents and GP contact, by age group (**Table 4**). After adjusting for sex, educational attainment, marital status, NCDs, and depressive symptoms at baseline, GP contact was associated with a lower risk of depressive symptoms during lockdown in the middle-aged group ($OR = 0.53$, $P = 0.005$). In the young and older groups, no significant differences were found between depressive symptoms among residents and GP contact during lockdown ($P > 0.05$).

Table 5 shows the associations between prevalent depressive symptoms and GP contact during lockdown according to educational attainment. After adjusting for age,

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241 sex, marital status, NCDs, and depressive symptoms at baseline, GP contact was
242 associated with a lower risk of depressive symptoms during the COVID-19 lockdown
243 among individuals in the groups with middle school or high school educational
244 attainment (OR = 0.60, $P = 0.007$). In the illiterate or primary school groups and the
245 college or above group, no significant relationships were found between depressive
246 symptoms and GP contact during lockdown ($P > 0.05$).

Discussion

In the present study, GP contact was negatively associated with prevalent depressive symptoms and new depressive symptoms among residents of Gongshu District, Hangzhou, China during the COVID-19 pandemic and lockdown between February and March, 2020. There was no difference in baseline depressive symptoms (from October 2018 to May 2019) between residents with and without GP contact.

Some strategies have been proposed for managing mental health during the pandemic. Although patients with or survivors of COVID-19²⁸, patients with severe mental illness²⁹, and health care workers³⁰ require mental health care, the general public also requires mental health attention during the COVID-19 pandemic and lockdown periods. Online-based cognitive behavioral therapy may be one effective solution³¹⁻³³. It is also important to promote communication of up-to-date information on the prevention and control of COVID-19 in consideration of mental health content^{34 35}. Improving management of community-based primary mental health care is an important goal³⁶. GPs are the foundation of community health services, including prevention, health education, basic clinical services, women and children's care, elder care, immunization, and physical rehabilitation.³⁷ In China, GPs are also known as family doctors or family physicians. In 2015, these contract services were implemented throughout Zhejiang Province³⁸. A previous study reported that services for mental health management had improved depressive symptoms among local residents via health education and organizational interventions³⁹.

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268 To the best of our knowledge, this is the first study to report the association of GP
269 contact with the mental health of individuals during COVID-19 lockdown periods.
270 Previous studies have reported the negative psychological impacts of quarantine^{9 40 41}
271 related to overwhelming stress levels owing to unemployment, deaths, and isolation
272 caused by the COVID-19 pandemic⁴². For this reason, relieving fear and anxiety in the
273 community is considered an important task⁴³. In the battle against COVID-19, GPs have
274 been involved in all aspects of the pandemic response. GPs with good communication
275 skills work with local community staff to perform daily health monitoring and provide
276 psychological support to help relieve fear and panic, such as through psychological
277 counseling via telephone- and internet-based communication. Local residents may have
278 greater reliance on GPs during an emergency, enabling these health professionals to
279 have an intervening role in residents' mental health during lockdown periods.

280 NCDs, including diabetes mellitus, endocrine dysfunction, cardiovascular diseases,
281 inflammation, and asthma, may occur concomitantly with diagnosed or undiagnosed
282 depression^{36 44}. Under normal circumstances, GPs provide health guidance to their
283 patients, with a particular focus on those with NCDs, via home visits, telephone contact,
284 or face-to-face consultations at community hospitals. Because patients with NCDs
285 receive more attention from and have closer relationships with GPs, they may rely more
286 on GPs during lockdown periods, in comparison with local residents who do not have
287 NCDs. Therefore, the mental health of residents with NCDs might be more strongly
288 influenced by GPs.

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4 289 In our study, we found that young (age 18–44 years old) and older (≥ 65 years old)
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7 290 residents had a higher proportion of depressive symptoms than middle-aged residents
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10 291 (age 45–64 years) during lockdown, with 26.6% of young people, 17.7% of middle-
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12 292 aged people, and 20.4% of older people indicating depressive symptoms. These results
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15 293 suggest that young and older people are more likely to be affected by the COVID-19
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18 294 epidemic, leading to depressive symptoms. Although in our study, the rates of GP
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20 295 contact increased from young to older age groups, only middle-aged residents who had
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23 296 contact with a GP showed a significant decrease in depressive symptoms. We
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26 297 speculated that middle-aged residents may be more capable of resisting the various
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29 298 pressures that can result in depression, making it easier for GPs to intervene positively
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31 299 in these patients' mental health.
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34 300 In the present study, we found a significant negative association of GP contact with
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37 301 a risk of having depressive symptoms only among local residents with middle or high
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40 302 school educational attainment. To understand why middle or high school education
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43 303 levels were an advantage in the association between depressive symptoms and GP
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46 304 contact, we additionally analyzed the age distribution in these groups ($n = 1,795$). We
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49 305 found that individuals in the middle-aged group ($n = 1,134$) constituted 63.2% of the
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52 306 total residents with middle or high school educational attainment, those in the young
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55 307 group ($n = 189$) constituted 10.5% of the total, and those in the older group ($n = 472$)
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58 308 constituted 26.3%. We speculated that the negative association between depressive
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symptoms and GP contact among people with middle or high school educational attainment was likely owing to most of these individuals being middle-aged.

The study has several strengths. First, the present study consisted of surveys of residents at baseline and during lockdown; which enabled comparisons of such points as mental health, health assessment, socioeconomic status, lifestyle, and disease condition among the residents between the baseline and lockdown periods. Additionally, the seasonal characteristics of the baseline and lockdown periods were similar because the baseline survey was conducted approximately 1 year ahead of lockdown. Second, the response rate in our follow-up survey was 81%, and we have built strong relationships with communities and residents. These relationships enabled us to conduct follow-up surveys to examine the situations of the residents during lockdown in this extremely difficult time. Third, we performed the stratified analysis of the relationship between depressive symptoms from different characteristics of the population and GP contact. The results would be helpful for proposing targeted strategy.

The study had several limitations that should be addressed. First, causation could not be established owing to the cross-sectional design of this study. Second, selection bias may exist. During the COVID-19 epidemic, telephone interviewing was used, which may have introduced volunteer bias. To identify the potential influence of selection bias, we conducted a non-response analysis by comparing the general characteristics between the study population (n = 3,153) and the population excluded from the study (n = 991). The results showed that the study population had higher

educational levels ($P < 0.05$) and had more NCDs ($P < 0.05$) than individuals who were excluded from the study (see Table S1). A potential explanation is that people with higher education levels and more health conditions may pay greater attention to their own health and would thus be more likely to participate in health-related research projects. Third, we defined depressive symptoms using the WHO-5, whose psychometric performance is not the same as that of traditional measures of depression, such as Zung's Self-Rating Depression Scale⁴⁵ and the 21-item DASS¹⁸. We recommend that future studies apply multiple approaches to precisely measure depression, including short-version screening tools, gold standard instruments, and clinical diagnosis, such as structured clinical interviews and functional neuroimaging⁴⁶⁻⁴⁸. Additionally, we did not record the reasons for contact with a GP.

In response to the high prevalence of common mental disorders, including depression and anxiety disorders, the WHO has proposed that primary care include mental health services⁴⁹. As the foundation of primary care in community health services and frontline workers in the prevention and control of infectious diseases in the community³⁷, GPs play an important role in mental health care in the community⁵⁰. The present study further supports the notion that GPs have an important role in improving mental health, including depressive symptoms, particularly during public health emergencies. Although the system of health provision by GPs is continually developing, when overwhelming numbers of patients require care, the quality and quantity of GP care is often insufficient^{37 51}. Thus, systems of health care provision by GPs in the community

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351 should be enhanced, particularly given the risk of further epidemic waves of COVID-
352 19. Additionally, with the advancement of COVID-19 vaccine development together
353 with the existing problem of vaccine hesitancy⁵², it is necessary to explore the impact
354 of GPs on COVID-19 vaccine uptake in future studies.

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Competing interests None declared.

Patient consent for publication Not required.

Data availability statement

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375 All data sharing and collaboration requests should be directed to the corresponding
376 authors (Shankuan Zhu, zsk@zju.edu.cn; Ann Hsing, annhsing@stanford.ed).

For peer review only

References

1. Organization WH. Coronavirus disease 2019 (COVID-19) update (Last updated: 2021-04-09) .
2. Xiong J, Lipsitz O, Nasri F, et al. Impact of COVID-19 pandemic on mental health in the general population: A systematic review. *J Affect Disord* 2020;277:55-64. doi: 10.1016/j.jad.2020.08.001 [published Online First: 2020/08/18]
3. Wang C, Chudzicka-Czupala A, Tee ML, et al. A chain mediation model on COVID-19 symptoms and mental health outcomes in Americans, Asians and Europeans. *Sci Rep* 2021;11(1):6481. doi: 10.1038/s41598-021-85943-7 [published Online First: 2021/03/21]
4. Organization WH. Mental health & COVID-19. *Coronavirus disease (COVID-19) 2020*
5. Le HT, Lai AJX, Sun J, et al. Anxiety and Depression Among People Under the Nationwide Partial Lockdown in Vietnam. *Front Public Health* 2020;8:589359. doi: 10.3389/fpubh.2020.589359 [published Online First: 2020/11/17]
6. Moghanibashi-Mansourieh A. Assessing the anxiety level of Iranian general population during COVID-19 outbreak. *Asian J Psychiatr* 2020;51:102076. doi: 10.1016/j.ajp.2020.102076 [published Online First: 2020/04/26]
7. Mazza C, Ricci E, Biondi S, et al. A Nationwide Survey of Psychological Distress among Italian People during the COVID-19 Pandemic: Immediate Psychological Responses and Associated Factors. *Int J Environ Res Public Health* 2020;17(9) doi: 10.3390/ijerph17093165 [published Online First: 2020/05/07]

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57
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60

8. Rossi R, Socci V, Talevi D, et al. COVID-19 Pandemic and Lockdown Measures Impact on Mental Health Among the General Population in Italy. *Front Psychiatry* 2020;11:790. doi: 10.3389/fpsy.2020.00790 [published Online First: 2020/08/28]

9. Gao J, Zheng P, Jia Y, et al. Mental health problems and social media exposure during COVID-19 outbreak. *PloS one* 2020;15(4):e0231924. doi: 10.1371/journal.pone.0231924

10. Guessoum SB, Lachal J, Radjack R, et al. Adolescent psychiatric disorders during the COVID-19 pandemic and lockdown. *Psychiatry research* 2020;291:113264. doi: 10.1016/j.psychres.2020.113264

11. Tran BX, Nguyen HT, Le HT, et al. Impact of COVID-19 on Economic Well-Being and Quality of Life of the Vietnamese During the National Social Distancing. *Front Psychol* 2020;11:565153. doi: 10.3389/fpsyg.2020.565153 [published Online First: 2020/10/13]

12. Wang C, Chudzicka-Czupala A, Grabowski D, et al. The Association Between Physical and Mental Health and Face Mask Use During the COVID-19 Pandemic: A Comparison of Two Countries With Different Views and Practices. *Front Psychiatry* 2020;11:569981. doi: 10.3389/fpsy.2020.569981 [published Online First: 2020/10/10]

13. Wang C, Pan R, Wan X, et al. Immediate Psychological Responses and Associated Factors during the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the General Population in China. *Int J Environ Res Public Health* 2020;17(5) doi: 10.3390/ijerph17051729 [published Online First: 2020/03/12]

- 1
2
3
4 419 14. Wang C, Pan R, Wan X, et al. A longitudinal study on the mental health of general
5
6
7 420 population during the COVID-19 epidemic in China. *Brain Behav Immun* 2020;87:40-
8
9 421 48. doi: 10.1016/j.bbi.2020.04.028 [published Online First: 2020/04/17]
10
11
12 422 15. Hao F, Tan W, Jiang L, et al. Do psychiatric patients experience more psychiatric
13
14
15 423 symptoms during COVID-19 pandemic and lockdown? A case-control study with
16
17 424 service and research implications for immunopsychiatry. *Brain Behav Immun*
18
19 425 2020;87:100-06. doi: 10.1016/j.bbi.2020.04.069 [published Online First: 2020/05/01]
20
21
22
23 426 16. Tan W, Hao F, McIntyre RS, et al. Is returning to work during the COVID-19 pandemic
24
25
26 427 stressful? A study on immediate mental health status and psychoneuroimmunity
27
28 428 prevention measures of Chinese workforce. *Brain Behav Immun* 2020;87:84-92. doi:
29
30 429 10.1016/j.bbi.2020.04.055 [published Online First: 2020/04/27]
31
32
33
34 430 17. Hao F, Tam W, Hu X, et al. A quantitative and qualitative study on the neuropsychiatric
35
36 431 sequelae of acutely ill COVID-19 inpatients in isolation facilities. *Transl Psychiatry*
37
38 432 2020;10(1):355. doi: 10.1038/s41398-020-01039-2 [published Online First:
39
40 433 2020/10/21]
41
42
43
44 434 18. Wang C, Tee M, Roy AE, et al. The impact of COVID-19 pandemic on physical and
45
46 435 mental health of Asians: A study of seven middle-income countries in Asia. *PLoS One*
47
48 436 2021;16(2):e0246824. doi: 10.1371/journal.pone.0246824 [published Online First:
49
50 437 2021/02/12]
51
52
53
54 438 19. Nachege JB, Grimwood A, Mahomed H, et al. From Easing Lockdowns to Scaling-Up
55
56 439 Community-Based COVID-19 Screening, Testing, and Contact Tracing in Africa -
57
58
59
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440 Shared Approaches, Innovations, and Challenges to Minimize Morbidity and
441 Mortality. *Clinical infectious diseases : an official publication of the Infectious
442 Diseases Society of America* 2020 doi: 10.1093/cid/ciaa695

443 20. Vermeulen L, Schafer W, Pavlic DR, et al. Community orientation of general practitioners
444 in 34 countries. *Health policy* 2018;122(10):1070-77. doi:
445 10.1016/j.healthpol.2018.06.012

446 21. Shu Z, Wang L, Sun X. An evaluation of the effects of general practitioner-supported
447 patient noncommunicable diseases control model in Shanghai, China. *The
448 International journal of health planning and management* 2019;34(3):947-59. doi:
449 10.1002/hpm.2866

450 22. Zhang Y, Liu S, Sheng X, et al. Evaluation of a community-based hypertension self-
451 management model with general practitioners. *The International journal of health
452 planning and management* 2019;34(3):960-74. doi: 10.1002/hpm.2867

453 23. Leung K, Wu JT, Liu D, et al. First-wave COVID-19 transmissibility and severity in China
454 outside Hubei after control measures, and second-wave scenario planning: a
455 modelling impact assessment. *Lancet* 2020;395(10233):1382-93. doi:
456 10.1016/S0140-6736(20)30746-7

457 24. Xu S, Li Y. Beware of the second wave of COVID-19. *Lancet* 2020;395(10233):1321-22.
458 doi: 10.1016/S0140-6736(20)30845-X

459 25. Min Y, Zhao X, Hsing AW, et al. Cohort Profile: WELL living laboratory in China (WELL-
460 China). *International journal of epidemiology* 2021 doi: 10.1093/ije/dyaa283

- 1
2
3
4 461 26. Topp CW, Ostergaard SD, Sondergaard S, et al. The WHO-5 Well-Being Index: a
5
6
7 462 systematic review of the literature. *Psychotherapy and psychosomatics*
8
9 463 2015;84(3):167-76. doi: 10.1159/000376585
10
11
12 464 27. Health WCCiM. Chinese version of the WHO-Five Well-Being Index.
13
14
15 465 28. Council JPacMotS. Guideline for psychosocial support during the COVID-19 epidemic.
16
17 466 2020
18
19
20 467 29. China NHCo. Notifications of strengthening treatment and management of severe mental
21
22 468 illness during the COVID-19 epidemic. 2020. 2020
23
24
25 469 30. Zandifar A, Badrfam R, Mohammadian Khonsari N, et al. COVID-19 and medical staff's
26
27 470 mental health in educational hospitals in Alborz Province, Iran. *Psychiatry and clinical*
28
29 471 *neurosciences* 2020;74(9):499-501. doi: 10.1111/pcn.13098
30
31
32 472 31. Ho CS, Chee CY, Ho RC. Mental Health Strategies to Combat the Psychological Impact
33
34 473 of COVID-19 Beyond Paranoia and Panic. *Ann Acad Med Singap* 2020;49(3):155-60.
35
36 474 [published Online First: 2020/03/23]
37
38
39 475 32. Zhang MW, Ho RC. Moodle: The cost effective solution for internet cognitive behavioral
40
41 476 therapy (I-CBT) interventions. *Technol Health Care* 2017;25(1):163-65. doi:
42
43 477 10.3233/THC-161261 [published Online First: 2016/10/01]
44
45
46 478 33. Soh HL, Ho RC, Ho CS, et al. Efficacy of digital cognitive behavioural therapy for
47
48 479 insomnia: a meta-analysis of randomised controlled trials. *Sleep Med* 2020;75:315-
49
50 480 25. doi: 10.1016/j.sleep.2020.08.020 [published Online First: 2020/09/20]
51
52
53
54
55
56
57
58
59
60

- 1
2
3
4 481 34. Tran BX, Dang AK, Thai PK, et al. Coverage of Health Information by Different Sources in
5
6
7 482 Communities: Implication for COVID-19 Epidemic Response. *Int J Environ Res Public*
8
9 483 *Health* 2020;17(10) doi: 10.3390/ijerph17103577 [published Online First: 2020/05/24]
10
11
12 484 35. Tran BX, Phan HT, Nguyen TPT, et al. Reaching further by Village Health Collaborators:
13
14
15 485 The informal health taskforce of Vietnam for COVID-19 responses. *J Glob Health*
16
17 486 2020;10(1):010354. doi: 10.7189/jogh.10.010354 [published Online First: 2020/06/09]
18
19
20 487 36. Lotfaliany M, Bowe SJ, Kowal P, et al. Depression and chronic diseases: Co-occurrence
21
22
23 488 and communality of risk factors. *Journal of affective disorders* 2018;241:461-68. doi:
24
25 489 10.1016/j.jad.2018.08.011
26
27
28 490 37. Kong X, Yang Y. The current status and challenges of community general practitioner
29
30
31 491 system building in China. *QJM : monthly journal of the Association of Physicians*
32
33 492 2015;108(2):89-91. doi: 10.1093/qjmed/hcu222
34
35
36 493 38. Shang X, Huang Y, Li B, et al. Residents' Awareness of Family Doctor Contract Services,
37
38
39 494 Status of Contract with a Family Doctor, and Contract Service Needs in Zhejiang
40
41
42 495 Province, China: A Cross-Sectional Study. *International journal of environmental*
43
44 496 *research and public health* 2019;16(18) doi: 10.3390/ijerph16183312
45
46
47 497 39. Gilbody S, Whitty P, Grimshaw J, et al. Educational and organizational interventions to
48
49
50 498 improve the management of depression in primary care: a systematic review. *Jama*
51
52 499 2003;289(23):3145-51. doi: 10.1001/jama.289.23.3145
53
54
55
56
57
58
59
60

- 1
2
3
4 500 40. Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how
5
6
7 501 to reduce it: rapid review of the evidence. *Lancet* 2020;395(10227):912-20. doi:
8
9 502 10.1016/S0140-6736(20)30460-8
10
11
12 503 41. Lai J, Ma S, Wang Y, et al. Factors Associated With Mental Health Outcomes Among
13
14 504 Health Care Workers Exposed to Coronavirus Disease 2019. *JAMA network open*
15
16 505 2020;3(3):e203976. doi: 10.1001/jamanetworkopen.2020.3976
17
18
19 506 42. Shader RI. COVID-19 and Depression. *Clin Ther* 2020;42(6):962-63. doi:
20
21 507 10.1016/j.clinthera.2020.04.010 [published Online First: 2020/05/05]
22
23
24 508 43. Li DKT, Zhu S. Contributions and challenges of general practitioners in China fighting
25
26 509 against the novel coronavirus crisis. *Family medicine and community health*
27
28 510 2020;8(2):e000361. doi: 10.1136/fmch-2020-000361
29
30
31 511 44. Memel D. Chronic disease or physical disability? The role of the general practitioner. *The*
32
33 512 *British journal of general practice : the journal of the Royal College of General*
34
35 513 *Practitioners* 1996;46(403):109-13.
36
37
38 514 45. Dunstan DA, Scott N, Todd AK. Screening for anxiety and depression: reassessing the
39
40 515 utility of the Zung scales. *BMC Psychiatry* 2017;17(1):329. doi: 10.1186/s12888-017-
41
42 516 1489-6 [published Online First: 2017/09/10]
43
44
45 517 46. Husain SF, Yu R, Tang TB, et al. Validating a functional near-infrared spectroscopy
46
47 518 diagnostic paradigm for Major Depressive Disorder. *Sci Rep* 2020;10(1):9740. doi:
48
49 519 10.1038/s41598-020-66784-2 [published Online First: 2020/06/18]
50
51
52
53
54
55
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42
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46
47
48
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50
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52
53
54
55
56
57
58
59
60

47. Husain SF, Tang TB, Yu R, et al. Cortical haemodynamic response measured by functional near infrared spectroscopy during a verbal fluency task in patients with major depression and borderline personality disorder. *EBioMedicine* 2020;51:102586. doi: 10.1016/j.ebiom.2019.11.047 [published Online First: 2019/12/27]

48. Ho CSH, Lim LJH, Lim AQ, et al. Diagnostic and Predictive Applications of Functional Near-Infrared Spectroscopy for Major Depressive Disorder: A Systematic Review. *Front Psychiatry* 2020;11:378. doi: 10.3389/fpsyt.2020.00378 [published Online First: 2020/06/02]

49. Organization WH. Integrating Mental health into primary care: A global perspective. Geneva: WHO 2008

50. Lam TP SK, Piterman L, Lam KF, Poon MK, See C, Wu D. Impact of training for general practitioners on their mental health services: The Hong Kong experience. *Australian journal of general practice* 2018;47(8):6.

51. Zhang Y, Zhao Q, Hu B. Community-based prevention and control of COVID-19: Experience from China. *American journal of infection control* 2020;48(6):716-17. doi: 10.1016/j.ajic.2020.03.012

52. Chew NWS, Cheong C, Kong G, et al. An Asia-Pacific study on healthcare workers' perceptions of, and willingness to receive, the COVID-19 vaccination. *Int J Infect Dis* 2021;106:52-60. doi: 10.1016/j.ijid.2021.03.069 [published Online First: 2021/03/31]

Table 1. Sociodemographic characteristics, NCDs, and GP contact among participants

Variables	Total (n = 3,153)	GP contact		P
		No (n = 2,704)	Yes (n = 449)	
Age, y (mean \pm SD)	55.5 \pm 12.9	55.0 \pm 12.9	59.0 \pm 12.0	<0.001
Age Stratification, n (%)				<0.001
18-44	613 (100)	557 (90.9)	56 (9.1)	
45-64	1698 (100)	1474 (86.8)	224 (13.2)	
≥ 65	842 (100)	673 (79.9)	169 (20.1)	
Gender, n (%)				0.14
Male	1186 (100)	1003 (84.6)	183 (15.4)	
Female	1967 (100)	1701 (86.5)	266 (13.5)	
Educational attainment, n (%)				<0.001
Illiterate or primary school	672 (100)	563 (83.8)	109 (16.2)	
Middle school or high school	1795 (100)	1518 (84.6)	277 (15.4)	
College or above	686 (100)	623 (90.8)	63 (9.2)	
Marital status, n (%)				0.04
Married/ remarried	2915 (100)	2489 (85.4)	426 (14.6)	
Unmarried /Divorced/ separate	238 (100)	215 (90.3)	23 (9.7)	
NCDs, n (%)				<0.001
Without	1168 (100)	1047 (89.6)	121 (10.4)	
With	1985 (100)	1657 (83.5)	328 (16.5)	

GP, general practitioner; NCD, noncommunicable disease; SD, standard deviation.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Data of GP contact with residents are from the follow-up survey during COVID-19 lockdown.

Table 2. Association of GP contact with depressive symptoms among residents

Variables	Total	GP contact	
		No	Yes
Depressive symptom	n (%)	n (%)	n (%)
Prevalent			
Baseline	n = 3,153	n = 2,704	n = 449
(before lockdown)			
No	2,722 (86.3)	2,329 (86.1)	393 (87.5)
Yes	431 (13.7)	375 (13.9)	56 (12.5)
Model 1 OR (95%CI), P		Ref	0.96 (0.70-1.29), 0.77
Model 2 OR (95%CI), P		Ref	0.94 (0.70-1.28), 0.71
Prevalent			
Lockdown	n = 3153	n = 2,704	n = 449
No	2,517 (79.8)	2,135 (79.0)	382 (85.1)
Yes	636 (20.2)	569 (21.0)	67 (14.9)
Model 1 OR (95%CI), P		Ref	0.68 (0.52-0.90), 0.007
Model 2 OR (95%CI), P		Ref	0.67 (0.51-0.88), 0.004
Model 3 OR (95%CI), P		Ref	0.67 (0.51-0.89), 0.005
Incident*	n = 2,722	n = 2,329	n = 393
No	2,210 (81.2)	1,873 (80.4)	337 (85.8)
Yes	512 (18.8)	456 (19.6)	56 (14.2)
Model 1 OR (95%CI), P		Ref	0.70 (0.52-0.95), 0.02
Model 2 OR (95%CI), P		Ref	0.68 (0.51-0.93), 0.02

GP, general practitioner; NCD, noncommunicable disease; OR, odds ratio; CI, confidence interval.

Model 1: Adjusted for age, sex, educational attainment, marital status.

Model 2: Further adjusted for NCDs.

Model 3: Further adjusted for depressive symptoms at baseline.

* Individuals who reported no depressive symptoms at baseline but reported depressive symptoms at the follow-up interview in April 2020.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Data of GP contact with residents are from the follow-up survey during COVID-19 lockdown.

Data of depressive symptoms from baseline and follow-up surveys.

Table 3. Association between GP contact and prevalent depressive symptoms among residents stratified by NCD groups

Without NCDs n = 1,168				With NCDs n = 1,985		
	Without contact	With contact		Without contact	With contact	
		OR (95% CI)	P		OR (95% CI)	P
Model 1	Ref	0.69 (0.40-1.20)	0.19	Ref	0.66 (0.48-0.92)	0.01
Model 3	Ref	0.69 (0.40-1.20)	0.19	Ref	0.67 (0.48-0.92)	0.01

GP, general practitioner; NCD, noncommunicable disease; OR, odds ratio; CI, confidence interval.

Model 1: Adjusted for age, sex, educational attainment, marital status.

Model 3: Further adjusted for depressive symptoms at baseline.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Data of GP contact with residents are from the follow-up survey during COVID-19 lockdown.

Data of depressive symptoms are from baseline and follow-up surveys.

Table 4. Association between GP contact and prevalent depressive symptoms among residents stratified by age group

	18-44 years n = 613			45-64 years n = 1,698			≥65 years n = 842		
	Without contact	With contact OR (95% CI)	P	Without contact	With contact OR (95% CI)	P	Without contact	With contact OR (95% CI)	P
Model 1	Ref	0.78 (0.40-1.53)	0.48	Ref	0.55 (0.35-0.85)	0.007	Ref	0.81 (0.52-1.25)	0.35
Model 2	Ref	0.77(0.40-1.52)	0.46	Ref	0.53 (0.34-0.82)	0.004	Ref	0.81 (0.52-1.25)	0.34
Model 3	Ref	0.76 (0.38-1.48)	0.42	Ref	0.53 (0.34-0.82)	0.005	Ref	0.81 (0.52-1.25)	0.34

GP, general practitioner; NCD, noncommunicable disease; OR, odds ratio; CI, confidence interval.

Model 1: Adjusted for sex, educational attainment, marital status.

Model 2: Further adjusted for NCDs.

Model 3: Further adjusted for depressive symptoms at baseline.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Data of GP contact with residents are from the follow-up survey during COVID-19 lockdown.

Data of depressive symptoms are from baseline and follow-up surveys.

Table 5. Association between GP contact and prevalent depressive symptoms among residents stratified by educational attainment

	Illiterate or primary school n = 672			Middle school or high school n = 1,795			College or above n = 686		
	Without contact	With contact OR (95% CI)	P	Without contact	With contact OR (95% CI)	P	Without contact	With contact OR (95% CI)	P
Model 1	Ref	0.79 (0.46-1.39)	0.41	Ref	0.62 (0.43-0.89)	0.01	Ref	0.75 (0.39-1.46)	0.40
Model 2	Ref	0.78(0.45-1.37)	0.39	Ref	0.60 (0.42-0.87)	0.007	Ref	0.75 (0.38-1.45)	0.39
Model 3	Ref	0.78(0.44-1.37)	0.39	Ref	0.60 (0.42-0.87)	0.007	Ref	0.75 (0.39-1.46)	0.40

GP, general practitioner; NCD, noncommunicable disease; OR, odds ratio; CI, confidence interval.

Model 1: Adjusted for age, sex, marital status.

Model 2: Further adjusted for NCDs.

Model 3: Further adjusted for depressive symptoms at baseline.

Data of sociodemographic characteristics and NCDs among residents are from the baseline survey.

Table S1. Non-response analysis (N=4144)

Variables	Participants	Non-participants	P
	(n=3153)	(n =991)	
Age, y (mean ± SD)	55.5 ± 12.9	55.6 ± 12.5	0.789
Age Stratification, n (%)			0.112
18-44	613 (19.4)	171 (17.3)	
45-64	1698 (53.9)	570 (57.5)	
≥65	842 (26.7)	250 (25.2)	
Gender, n (%)			0.185
Male	1186 (37.6)	396 (40.0)	
Female	1967 (62.4)	595 (60.0)	
Educational attainment, n (%)			<0.001
Illiterate or primary school	672 (21.3)	254 (25.6)	
Middle school or high school	1795 (56.9)	536 (54.1)	
College or above	686 (21.8)	166 (16.8)	
Marital status, n (%)			0.816
Married/ remarried	2915 (92.5)	886 (89.4)	
Unmarried /Divorced/ separate	238 (7.5)	70 (7.1)	
NCDs, n (%)			0.005
Without	1168 (37.0)	403 (40.7)	
With	1985 (63.0)	556 (56.1)	
Baseline depressive symptoms, n(%)			0.386
Without	2722 (86.3)	813 (82.0)	
With	431 (13.7)	141 (14.2)	

NCD, noncommunicable disease; SD, standard deviation.

Educational attainment: missing 35 (3.5%), marriage: missing 35 (3.5%), NCDs: missing 32 (3.2%), baseline depressive symptoms: missing 37 (3.7%).

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

	Item No	Recommendation	Page
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,3
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found.	3,4
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-8
Objectives	3	State specific objectives, including any prespecified hypotheses	8
Methods			
Study design	4	Present key elements of study design early in the paper	9
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	9,10
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	9
		(b) For matched studies, give matching criteria and number of exposed and unexposed	Not available
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9,10
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9,10
Bias	9	Describe any efforts to address potential sources of bias	Not available
Study size	10	Explain how the study size was arrived at	9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9,10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11
		(b) Describe any methods used to examine subgroups and interactions	11
		(c) Explain how missing data were addressed	Not available
		(d) If applicable, explain how loss to follow-up was addressed	Not available
		(e) Describe any sensitivity analyses	Not available
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9,13
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	Not available
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	13
		(b) Indicate number of participants with missing data for each variable of interest	9
		(c) Summarise follow-up time (eg, average and total amount)	9
Outcome data	15*	Report numbers of outcome events or summary measures over time	13
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-15
		(b) Report category boundaries when continuous variables were categorized	14-15
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not available

Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	14,15
Discussion			
Key results	18	Summarise key results with reference to study objectives	16
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	19,20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	17-21
Generalisability	21	Discuss the generalisability (external validity) of the study results	19,20
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	22

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.